Penta Quark Search in $\sqrt{s_{NN}}$=200 GeV Au+Au Collisions at RHIC-PHENIX

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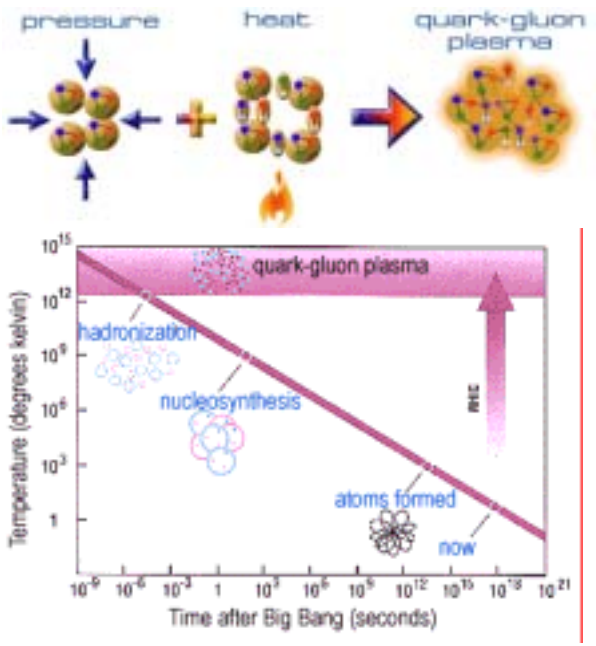
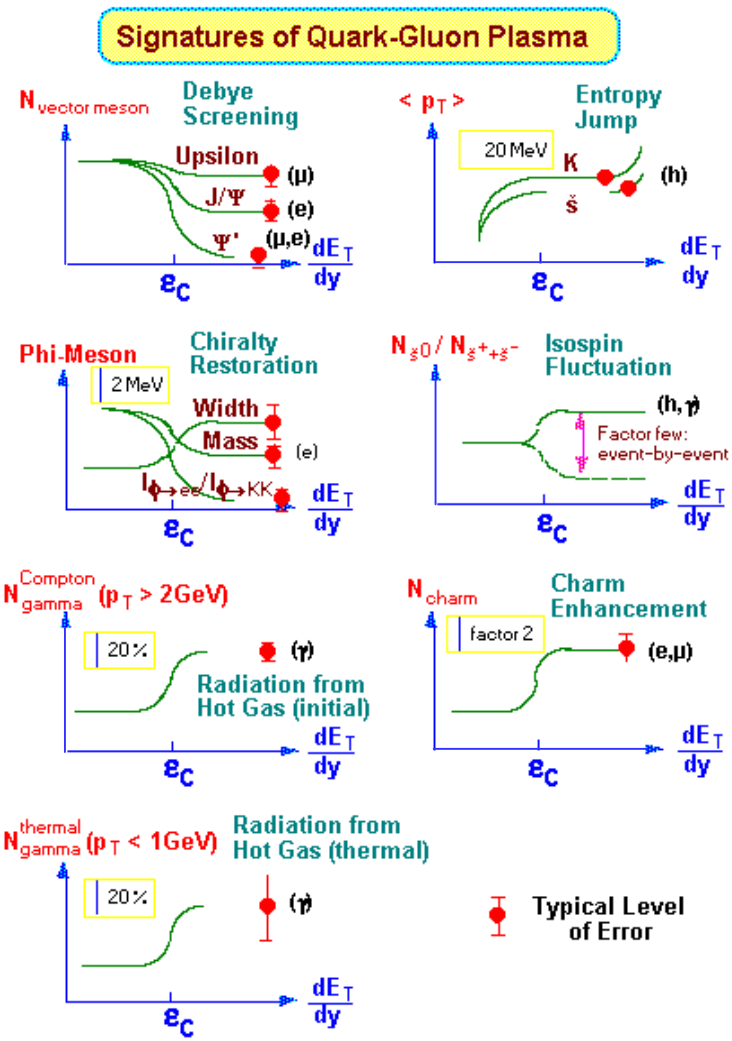
Our Goal, QGP Search at RHIC

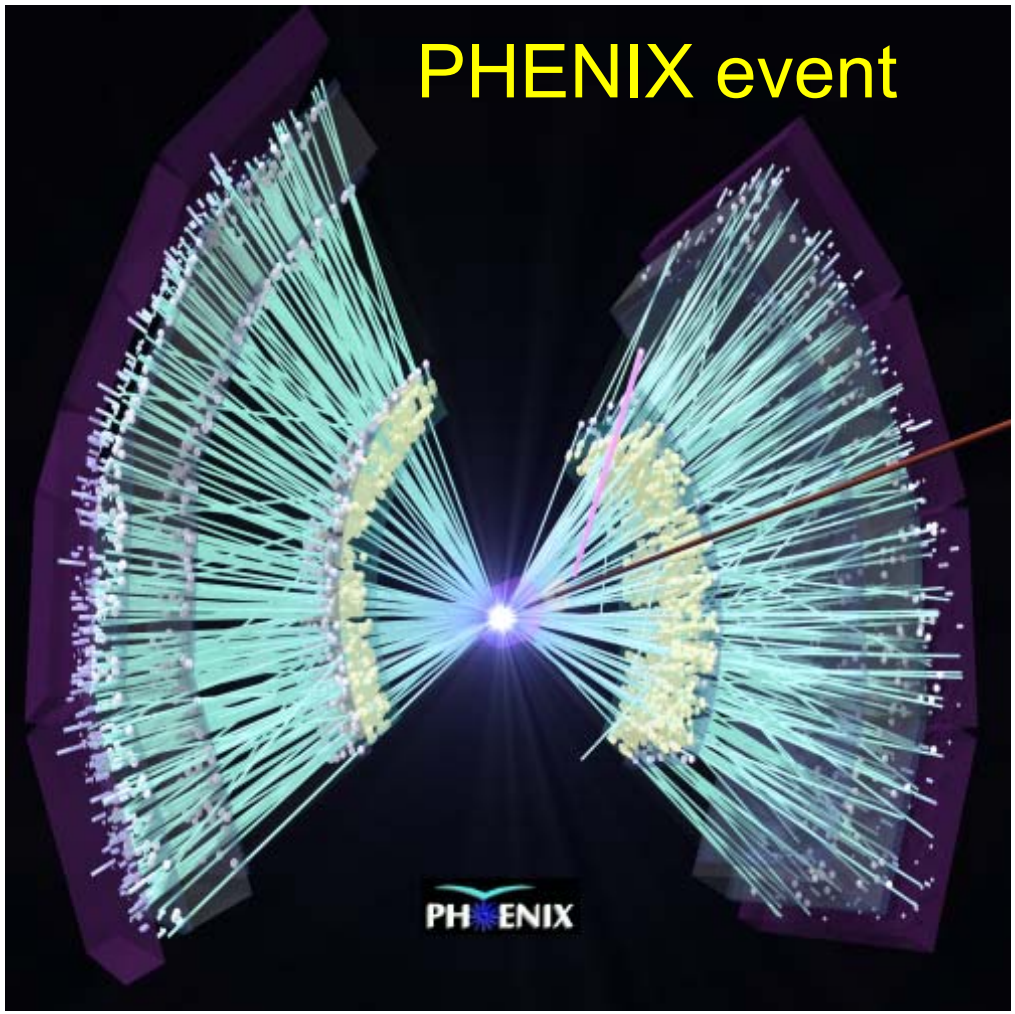
- Quark-Gluon Plasma
  - A new state of matter under high pressure and/or temperature
  - Existence predicted by QCD
    - In early universe, neutron star, and relativistic heavy ion collisions

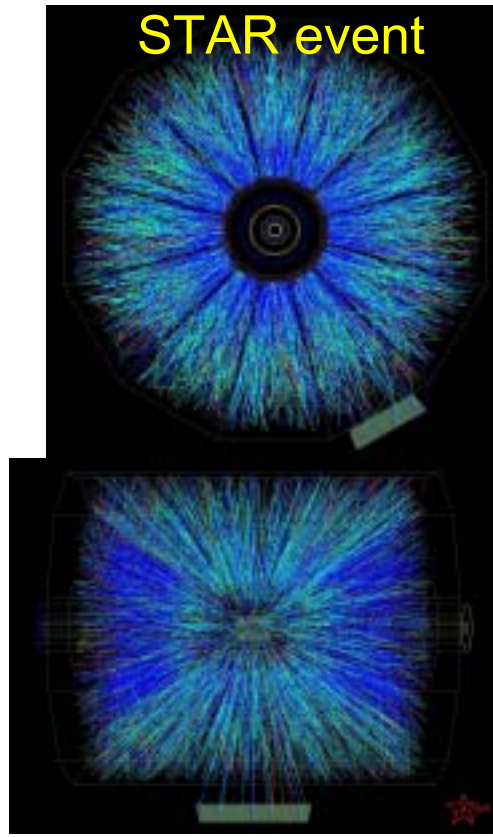




200 GeV Au+Au Collisions

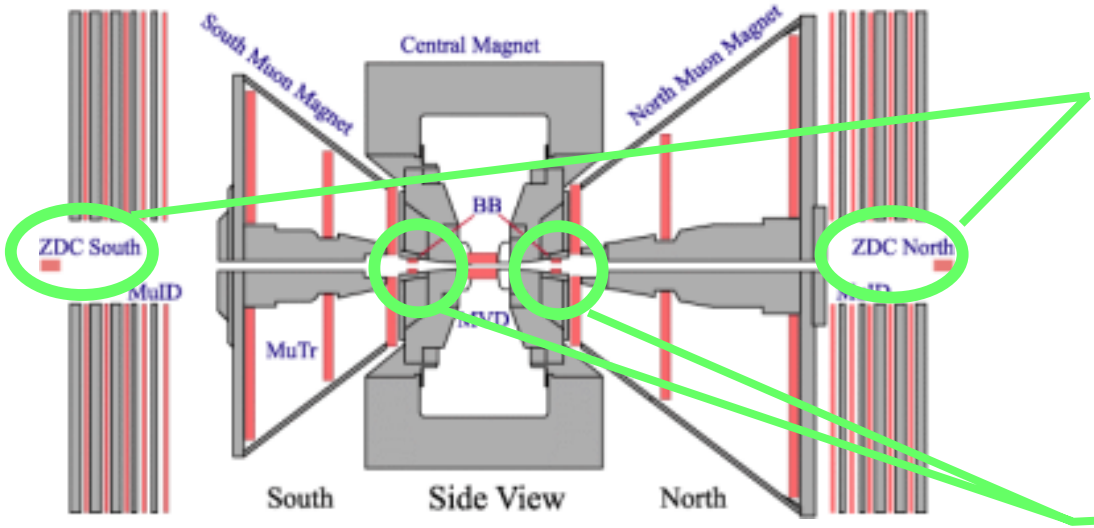
- ~5000 charged particles produced

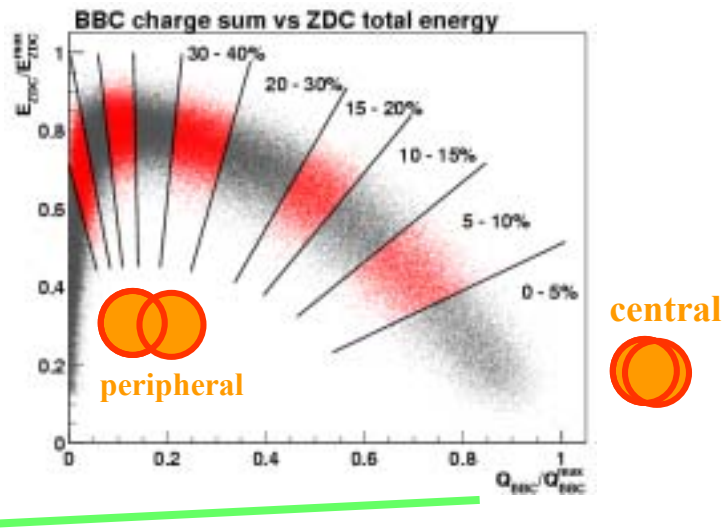




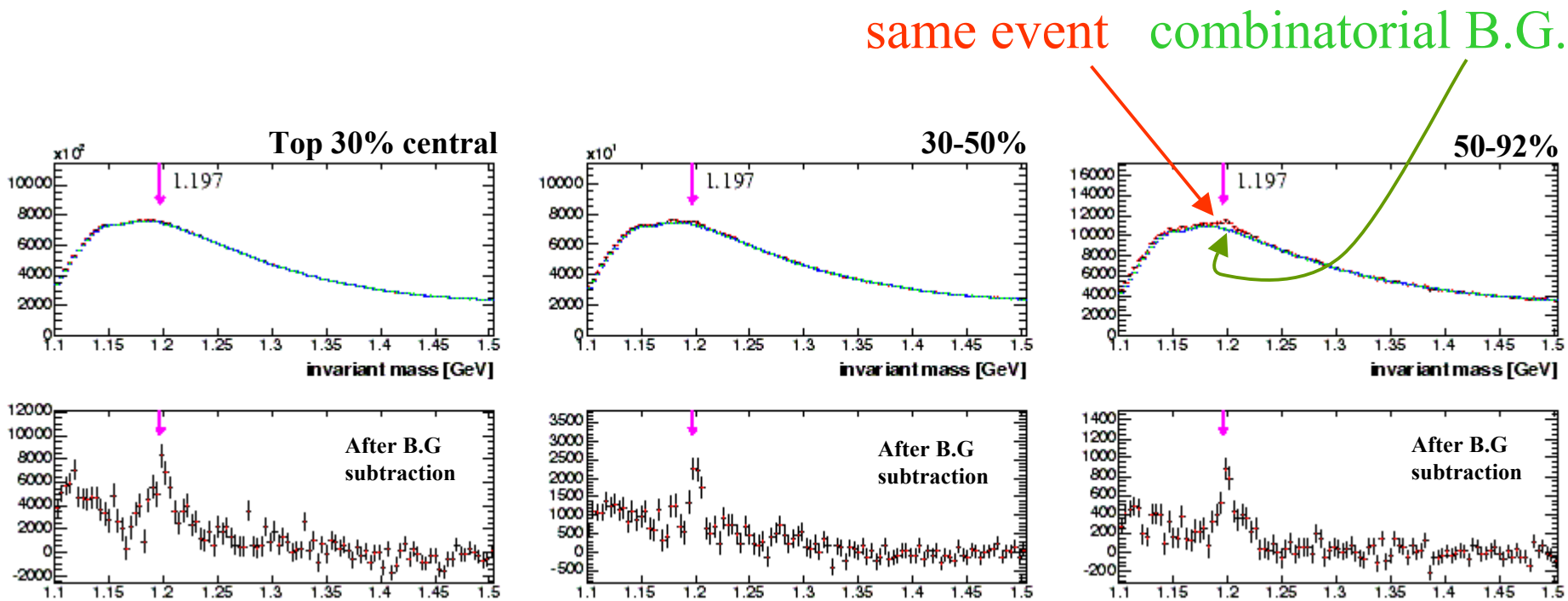
Event Selection and Analysis

- Minimum bias data in 200 GeV Au+Au
  - ~36M events
- Three centrality bins
  - top30%, 30-50%, 50-92%
- Charged track and anti-n reconstruction
  - same with *p*+*p* analysis (shown in previous talk)
- Invariant mass calculation
  - event mixing method



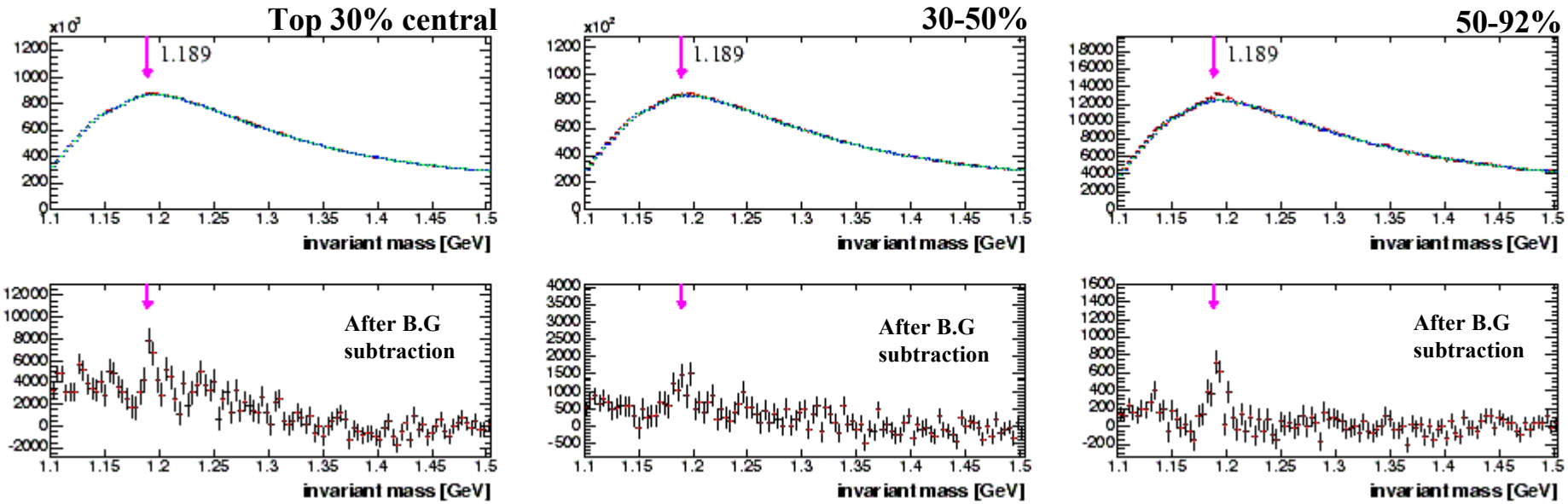


$\pi^+ + \bar{n}$



- Anti-Σ^+ ($\leftarrow \pi^+ + n$ (99.8% B.R.)) peak is seen
- It is the first measurement at RHIC

$\pi^- + \bar{n}$



- Anti-Σ^- ($\leftarrow \pi^- + n$ (48.3% B.R.)) peak is seen
- It is also the first measurement at RHIC

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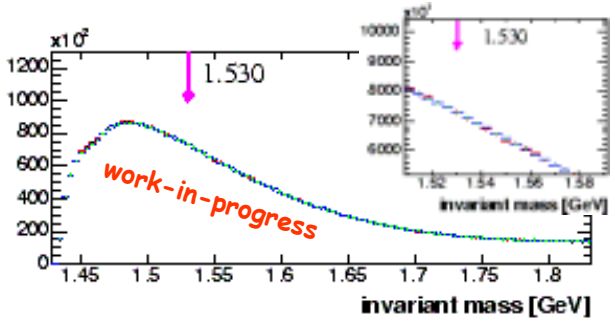
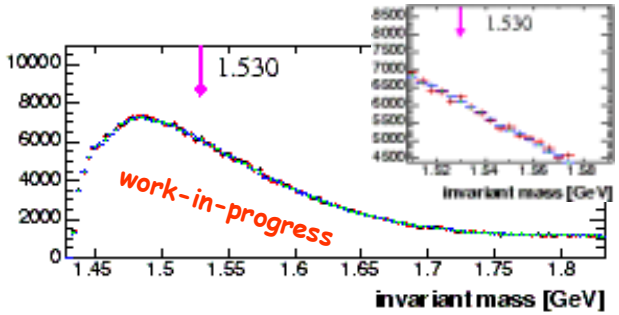
$K^- + \bar{n}$

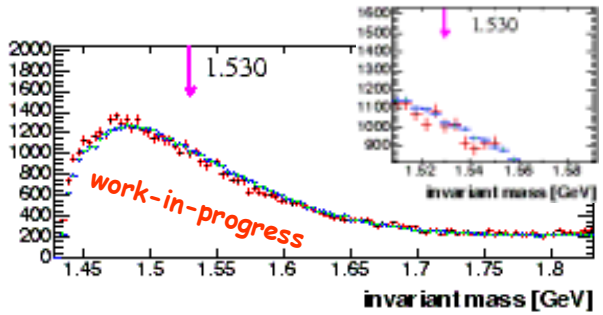
Top 30% central



30-50%



50-92%



- No significant result in K^- + anti-n invariant mass distributions within Run-2 statistics

Summary

- We can not see any significant peak in K^- + anti-n invariant mass distribution within Run-2 statistics
- We need much more work to define upper limit, because the efficiency estimation is in progress
- RHIC Run-4 will have more than 50 times of data from Run-2, we may show a statement from run-4 in future

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Backup

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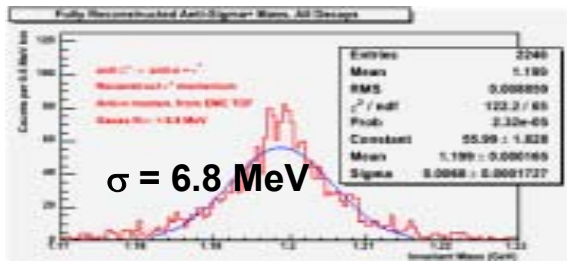
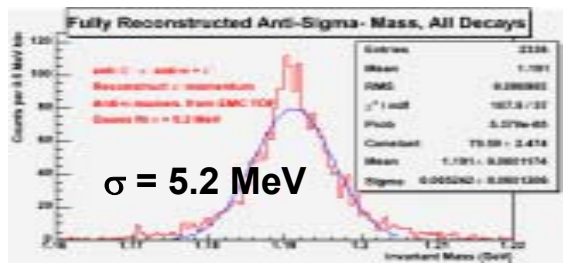
Monte-Carlo study (by C. Maguire)

- Mass resolution study from GEANT
  - charged track + anti-n
  - here mass width=0 is assumed

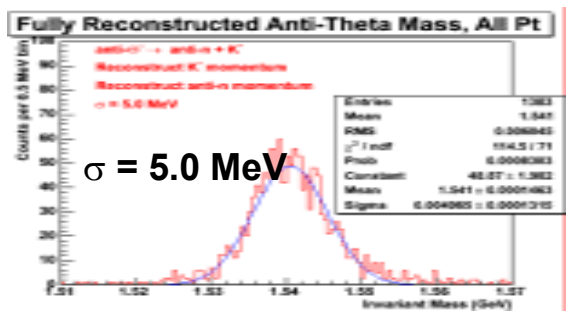
$$\text{Anti-}\Sigma^{+} \rightarrow \pi^{+} + \text{nbar}$$



$$\text{Anti-}\Sigma^{-} \rightarrow \pi^{-} + \text{nbar}$$



$$\text{Anti-}\Theta^{-} \rightarrow K^{-} + \text{nbar}$$



Integrated Luminosity

- Total geometrial Au+Au cross section is 6847±542 mb
- Total number of event from our analysis after event selection is 36.27×10^6
- Then total integrated Luminosity is
  - 36.27×10^6 / (6847±542 [mb])
    = 5.29 +0.46 -0.38 [$(\mu b)^{-1}$]

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